

**Amendments to the Specification:**

Please amend the specification as follows:

Please replace the paragraph at page 6, line 10, with the following rewritten paragraph:

Fig. 3b is a sketch of ~~[[and]]~~ an integrated cantilever system with integrated nanowire piezoresistor array at its base.

Please replace the paragraph starting at page 10, line 22, with the following rewritten paragraph:

The scheme of embedded nanowire piezoresistor array 20 is illustrated in Fig. 3b, where arrays of nanowires are patterned above two arms 24 of the cantilever 22. The arms 24 of the cantilevers 22 act as an efficient strain concentrator and amplify the torque induced by biological species. The nanowires 12 can be laid out in parallel circuit as shown in Fig. 3b at the base of the cantilever 22 or in a serpentine serial circuit as shown in the inset in ~~Fig. 3b~~ Fig. 3a.

Please replace the paragraph starting at page 15, line 2, with the following rewritten paragraph:

Geometrical effect piezoresistors normally provide a smaller gauge factor, nevertheless they represent a significant amount of materials used in commercial gauge sensors. These materials are mostly highly conductive thin metal films with very low resistivity. To obtain a larger change in the absolute value of resistance, a lot of effort has been expended to increase the resistance of the sensors. However, for high frequency applications, it is beneficial to maintain a low sensor resistance in order to match the resistance of the sensor with that of the measurement circuit, which is typically 50  $\Omega$ . Fig 4a shows a representative measurement diagram. The signal ~~appear~~ appears at the input of the network analyzer or lock in amplifiers is,

$$V = V_s \frac{R_0}{R_s + R_0} \quad (9)$$

Where  $R_0$  is the input impedance of the measurement amplifier as shown in Fig. 4b and  $R_s$  is thin film or nanowire resistance, and  $V_s$  is the ac signal ( $I_b \times GF \times R_s$ ) applied signal across the thin film with  $I_b$  the bias current applied to the nanowire 12. The maximum signal power spectrum is transferred only when  $R_s = R_0$ . In this way, the transducer signal will not be significantly degraded. Normally the sheet resistance of semiconducting thin film is on the order of  $10^2 \Omega$  to  $10^3 \Omega$ . The two-terminal DC resistance of a high aspect ratio nanowire 12 could be  $10^6 \Omega$ . This makes semiconducting nanowires 12 extremely difficult to be used as a sensing unit in high frequency mechanical resonator. On the other hand, the resistance of metal films can be easily trimmed to specific values by tuning the thickness of the film.

Please replace the paragraph starting at page 18, line 4, with the following rewritten paragraph:

Our choice of thin film metallic materials to construct nanowires 12 is largely dependent on the actual fabrication process and the conductivity of the metal. Many methods of deposition methods can be employed: evaporation, sputtering, CVD, etc. For embedded metal wires, the design is straightforward in the sense that only the surface strain is required to be measured. In the case of the free-standing metal nanowires, the fabrication is not trivial. Usually a bimorph structure has to be incorporated to avoid the compensation of tensile strain and compressive strain at the top surface 26 and bottom surface 28 of the suspended beam or wire 12 as shown in ~~Fig-8~~ Fig. 6. The bottom layer 28 of the bimorph structure is usually insulating or has higher resistivity than the piezoresistor to gain maximum strain sensitivity. For thin film metal piezoresistors, the bottom layer 28 could be simply another higher resistive metal layer such as Au/Cr or a semiconductor such as Metal/Si, Metal/SiC, Metal/GaAs etc. or an insulating layer such as Metal SiO<sub>2</sub>, Metal/SiN, Metal/SiNO etc.

Please replace the paragraph at page 21, line 2, with the following rewritten paragraph:

Fig. 7 is a graph which shows the room temperature piezoresistive coefficients of both p-type silicon and n-type silicon in the (100) plane. It can be seen that p-type silicon has its maximum piezoresistive coefficient of  $-72 \times 10^{-11} \text{ m}^2/\text{N}$  in the  $\langle 110 \rangle$  direction; while n-type silicon has its maximum of  $-103 \times 10^{-11} \text{ m}^2/\text{N}$  in the  $\langle 100 \rangle$  direction. Although n-type silicon can achieve piezoresistive coefficients much higher than that of p-type silicon, all piezoresistive sensors fabricated to date, including pressure sensors, accelerometers, and AFM cantilevers are doped p-type. This is partially for historical reasons. Traditional MEMS's rely on wet etching of Si, such as TMAH and KOH etchants, which etch silicon preferentially to expose the (111) plane. Therefore the membrane edge of the front side is always in parallel to  $\langle 110 \rangle$  direction, where p silicon has maximum piezoresistive coefficient while n silicon has minimum piezocoefficient. ~~By~~ By using a deep reactive ion etching DRIE technique, nanowires or nanocantilevers 12 can be easily patterned and released along any chosen crystal orientation, therefore improving the piezoresistivity.

Please replace the paragraph starting at page 22, line 21, with the following rewritten paragraph:

It is generally known that GaAs electronic circuits have a higher tolerance in high temperature and high radiation environments ~~than that in silicon integrated circuits~~ than that of silicon integrated circuits. On the other hand, GaAs membranes can be easily obtained by selectively etching the GaAs/AlGaAs heterostructures. In addition, GaAs nanowires are compatible with integrated high electron mobility transistor (HEMT) amplifiers. This becomes extremely important when the impedance of the piezoresistive wires are significantly larger than the input resistance of the measurement circuits.